Case Report

Migration of a Kirschner wire into the spinal cord: A case report and literature review

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Context: A Kirschner wire (K-wire) is a stainless steel pin with at least one sharpened tip that is mainly used for the internal fixation of bone fractures. While some cases of K-wire dislocation and migration have been reported as complications after fracture surgery, the intraspinal migration of a K-wire is rare. Herein, we report a case in which a K-wire used for sternal fixation 7 years earlier migrated into the spinal canal.

Findings: A 68-year-old male suddenly sustained severe radiating pain and numbness in his left upper extremity, and walked to our hospital. He had mild weakness in the left wrist extensor muscles and the left extensor digitorum. CT-myelography revealed a K-wire penetrating into the spinal cord at C5-6. There was no injury of the trachea, esophagus, or blood vessels. The patient had a history of surgical infection after cardiovascular surgery seven years before, and had undergone surgical debridement and sternum fixation with two K-wires. One K-wire had broken, and part of it migrated upward. Using an anterior approach, we detected the tip of K-wire below the left sternocleidomastoid muscle. We cut the K-wire into 1 to 2-cm pieces and removed it piece by piece. His postoperative course was uneventful and the symptoms improved markedly after the surgery.

Conclusion: This is the first report of a K-wire that had been used for sternal fixation migrating into the spinal cord. This case illustrates that although rare, it is possible for a K-wire to migrate upward after sternal fixation.

Keywords: Kirschner wire, Migration, Spinal cord, Sternal fixation, Cervical spine

Manuscript

Context

A Kirschner wire (K-wire) is a stainless steel pin with at least one sharpened tip that was introduced by Martin Kirschner[1] in 1909 and is now mainly used for the internal fixation of bone fractures. The advantages of a K-wire are the relative ease of its insertion and removal, which causes minimal trauma.[2] While some cases of K-wire dislocation and migration have been reported as complications after fracture surgery,[3,4] the intraspinal migration of a K-wire is extremely rare. Herein, we report a case in which a K-wire used for sternal fixation 7 years earlier migrated into the spinal canal.

Case presentation

A 68-year-old male patient suddenly experienced a pain in the back of his neck and severe radiating pain and numbness in his left upper extremity upon awakening. He visited the hospital immediately after the onset of his symptoms.

The patient had no history of trauma or cervical spine disease. He had undergone a coronary artery bypass graft surgery for a myocardial infarction seven years earlier. Postoperatively, he had developed a sternal infection, and surgical debridement of the infected lesion had been performed, requiring the fixation of the sternum using two K-wires.

At the time of the presently reported visit, a physical examination revealed pain and numbness that worsened when he flexed the cervical spine and a radiating pain in his left upper extremity. Muscle weakness, with a manual muscle testing (MMT) grade of 4, were observed for the left wrist extensor muscle and the left extensor digitorum. The deep tendon reflex of the left biceps was *hyperactive*. The results of the Jackson test and the Spurling test were both negative. The result of the 10-second test was 17 times for the left side, suggesting clumsiness of the left hand.

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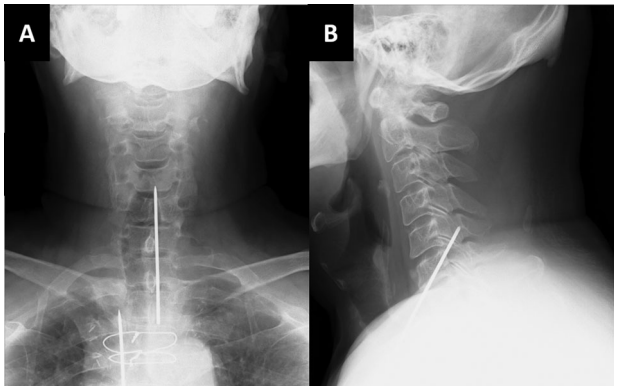

Figure 1 Serial radiographs of the cervical spine. An anterio-postero view (A) and a lateral view (B) show the penetration of the K-wire through the C6 vertebra and into the spinal canal.

A lateral view of a serial radiograph revealed the migration of a K-wire into his spinal canal, with penetration of the C6 vertebra (Fig. 1). The K-wire, which had been used for the sternum fixation 7 years earlier, had broken and had migrated upward (Fig. 2). A computed tomography (CT) scan revealed that the K-wire had penetrated the C6 vertebral body in a caudal-to-cephalad direction, and the tip of the K-wire was present in the posterior space of the spinal canal. No injuries to the trachea, esophagus, or blood vessels were observed. CT-myelography showed that the K-wire had penetrated the spinal cord slightly to the left and at the C5-6 level (Fig. 3). An upper gastrointestinal endoscopy confirmed the absence of any perforations of the pharynx or esophagus.

To avoid further penetration of the spinal cord, the K-wire was removed using an anterior approach. A 4-cm transverse incision in his anterior neck was made at a point located 1 cm cranially from the superior margin of the sternum. The K-wire was exposed below the left sternocleidomastoid muscle. It was difficult to remove the Kirschner wire in one piece because it was located deeply. To avoid ascending aorta injury, therefore, we cut it into 1 to 2-cm pieces, then removed piece-by-piece fashion. After all the pieces of K-wire had been removed, some leakage of the spinal fluid was observed. A drain tube was inserted and the fistula was sutured; the leakage was then confirmed to have stopped. No changes in the motor-evoked potentials were observed during the operation.

After the surgery, the patient's pain in his neck and upper extremity resolved and his muscle weakness improved. A dural fistula was not observed. An MRI examination performed one day after the operation showed a change in the intramedullary signal intensity at the C5-6 level (Fig. 4). The patient was discharged one week after surgery, and his postoperative course was uneventful.

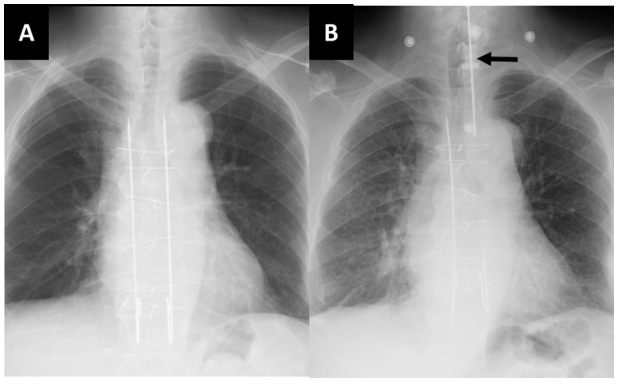

Figure 2 The patient had undergone sternal fixation using two K-wires 7 years earlier after developing a sternal infection following coronary artery bypass surgery (A). The K-wire to the left had broken and had been dislocated upward (B).

Discussion

The prevalence of K-wire migration after fixation surgery has been estimated as 5.8%-54%.[3,4] While most cases are asymptomatic or do not result in organ injury, a few reports have described K-wire migration into organs such as the lung,[5] heart,[6] liver,[7] and esophagus.[8] K-wire migration into the spinal canal is rare, and only 12 cases[9–20] have been reported to date (Table 1).

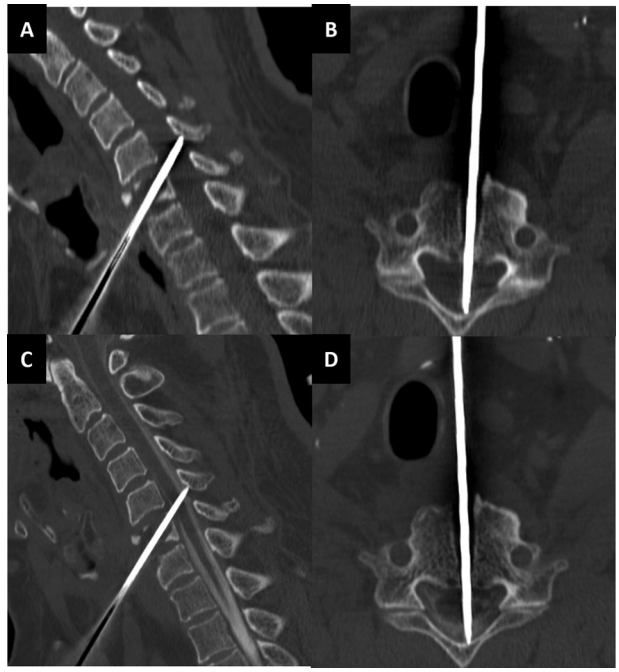

Figure 3 A plain CT of the cervical spine shows that the K-wire had penetrated the C6 vertebra and that the tip of the K-wire was located in the spinal canal (A, B). CT myelography shows the penetration of the spinal cord by the K-wire at the C5-6 level (C, D).

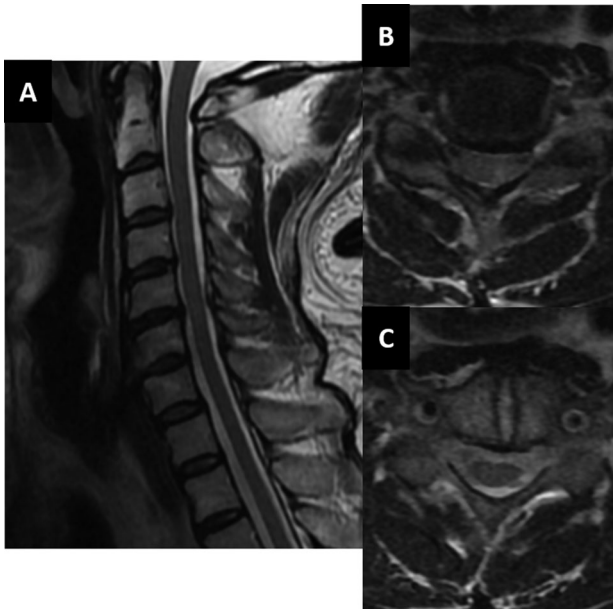

Figure 4 MRI of the cervical spine on the day after the operation. T2-weighted images of the sagittal (A) and axial (B: C5-6 level; C: C6 level) views show an intramedullary signal intensity at the C5-6 disc level, into which the K-wire had penetrated, but no hematoma or spinal fluid leakage was observed.

In all previously reported cases of intra-spinal migration, the migrated K-wire had been used in a shoulder operation, such as an open reduction internal fixation for a clavicle fracture and acromioclavicular joint dislocation. Therefore, the present case is the first reported case of a K-wire used for sternal fixation migrating into the spinal canal. According to previous reports, the surgical removals of the migrated K-wires were approached from a lateral direction in all the cases; however, the K-wire had entered the spinal canal in a direction toward the sagittal axis in the present case. Although the symptoms varied from asymptomatic[15,17,18] to quadriplegia[12] in the previous reports, the neurological symptoms were bilateral in all the symptomatic cases. In the present case, however, the patient exhibited unilateral radicular symptoms, since the direction of spinal canal penetration differed from that in the previously reported cases. While the timing of the intraspinal migration after the initial operation ranged from 26 days to 7 years in the previously reported cases,[9,11–20] the interval in the present case was 7 years.

Wire removal was performed in all previously reported cases. Bennis *et al.*[15] reported that following the same path and axis as the penetration was necessary during removal to prevent spinal cord damage and subsequent neurological deficits. Therefore, we performed the surgical wire removal using an anterior approach, since the K-wire was located anteriorly. Fransen *et al.*[14] reported a patient who underwent a laminectomy because of bleeding and spinal fluid leakage after K-wire removal. We were also prepared to perform decompression surgery in the event of postoperative neurological deterioration. Spinal fluid leakage has been reported in some cases after wire removal.[14,15] However, no reports of massive bleeding and uncontrollable spinal fluid leakage have been made.

Table 1

Author	Age/ Sex	Symptoms	Initial operation	Time until diagnosis of intra-spinal migration
Hinzpeter *et al.* (1977)*	N.D.	Optochiasmatic syndrome	Clavicular fixation	9 months
Conzen *et al.* (1986)*	N.D.	N.D.	Clavicular fixation	N.D.
Loncán *et al.* (1998)	22/M	Brown-Sequard syndrome	Clavicular fixation	2 months
Regel *et al.* (2002)	50/M	Tetraparesis, Loss of bladder function	Clavicular fixation	3 months
Pribán *et al.* (2005)	47/M	Paraparesis of lower limb	Acromioclavicular osteosynthesis	2 years
Fransen *et al.* (2007)	30/M	Paraparesis	Clavicular fixation	1 year
Bennis *et al.* (2008)	57/M	Asymptomatic	Clavicular fixation	4 months
Mamane *et al.* (2009)	34/M	No neurological defect	Clavicular fixation	2 months
Was *et al.* (2010)	66/M	Asymptomatic	Humeroscapular fixation	26 days
Li *et al.* (2013)	35/M	Asymptomatic	Acromioclavicular osteosynthesis	2 months
Minić *et al.* (2015)	30/M	Bilateral numbness	Clavicular fixation	4 months
Mankowski *et al.* (2016)	34/M	Neck pain	Acromioclavicular osteosynthesis	7 years
Our case	68/M	Neck pain, left upper limb pain and numbness	Sternum fixation	7 years

*Article in German. Full text not available.
N.D., not described.

In all the symptomatic cases,[11–14,19,20] the preoperative symptoms improved considerably after the removal of the K-wire. While the preoperative symptoms resolved completely in some symptomatic cases,[11,12,19,20] permanent sexual dysfunction,[13] and persistent moderate lower limb hypesthesia[14] have been reported. In the present case, both the patient's neck pain and neurological status improved significantly postoperatively.

Conclusion

This case was the first report of a K-wire that had been used for sternal fixation migrating into the spinal canal. Our case illustrates that although rare, it is possible for a K-wire to migrate to the spinal canal at some time after sternal fixation.

Disclaimer statements

Conflict of interest There are no conflicts of interest to declare.

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